

Chignecto Marine Transport Railway.

THE Isthmian TRANSIT
BETWEEN THE
BAY OF FUNDY
AND THE
GULF OF ST. LAWRENCE.

With Map.

H. G. C. KETCHUM,

M. Inst. C.E.

LONDON:
PRINTED BY WATERLOW AND SONS LIMITED, LONDON WALL.

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Dominion of Canada.

THE CHIGNECTO MARINE TRANSPORT RAILWAY.

THIS RAILWAY is projected and designed for the purpose of transporting steamers and sailing vessels, laden or otherwise, over the Isthmus of Chignecto, between the waters of the Gulf of St. Lawrence and the Bay of Fundy—a distance of seventeen miles.

The object is to save the circuitous and dangerous navigation of the Gut of Canso and the Atlantic coast of Nova Scotia; also to permit of propellers, paddle-wheel steamers, and other vessels, built and adapted only for inland waters, to continue their course from the St. Lawrence to St. John N.B., Portland and Boston—which is now impossible.

The distance thus saved would be not less than 600 miles between St. John and the chief cities of Canada, over the present route by the Gut of Canso.

submitted that The existing commerce between Canada and the United States ~~would~~ not only be greatly accommodated by the construction of this railway, but it ~~would~~ also be immensely

stimulated and developed. It would lead to a large trade between the western lake ports, and those of the New England States. A vessel loaded with grain may come direct from Chicago to Boston without breaking bulk when the Ship Railway is open for traffic.

The county of Cumberland, in Nova Scotia, abounds in coal; the counties in New Brunswick, bordering on the Head waters of the Bay of Fundy, are famed for their quarries of beautiful freestone, which adorns the leading avenues of New York, Philadelphia, and Boston; the deposits of coal, gypsum, lime and bituminous shales lie here comparatively undeveloped, because under present conditions, to reach a market in Quebec, Montreal, or Toronto, these products would have to be either conveyed by rail, or by sea around the Atlantic coast of Nova Scotia, an extra distance of 700 miles, the cost of either of which is prohibitory.

The output of coal in Nova Scotia, for 1882, was 1,365,811 tons, of which the mines at the head of the Bay of Fundy furnished 218,349 tons.

The productions of Prince Edward Island find a ready market in the New England cities, but they have at present to be forwarded via Cape Canso, to St. John, Portland, and Boston, a voyage which frequently ruins the cargoes of potatoes which, with like perishable products, require quick transit at cheap rates. The value of the freight expected from Prince Edward Island may be estimated by the fact that there is an annual surplus of two million bushels of potatoes alone to be sent abroad, besides other roots and cereals.

The north shore of New Brunswick and Nova Scotia abounds in timber which, if manufactured, would find quick sales in the United States, if only the ocean voyage could be saved. This timber is now lying waste for want of less expensive transit than now exists.

The fisheries of the Gulf of St. Lawrence are most important, as may be judged by the fact that the United States

Government paid to Canada the sum of \$5,500,000 for the right of fishing in Canadian waters.

The fishing fleet of the United States, consisting of about 600 vessels, frequenting these waters, would be enabled to make two trips during the season (instead of one) by the Ship Railway.

The fishing fleet of Canada consists of 1,150 vessels ; the average tonnage, 46,856 ; the average number of boats, 26,106 ; and the average number of men employed, 60,589.

The trade of Canada with the West Indies, Brazil and South America, increased from \$6,267,195 in 1876, to \$9,517,751 in 1882.

The open winter port of St. John, N.B., would naturally become the dépôt of all tropical products which would be forwarded as returned cargoes in exchange for the manufactures and productions of the Western Provinces of the Dominion.

The following table, taken from official returns, shews the trade of Canada with those countries for the year ending 30th June, 1882 :—

	Imports.	Exports.
British West Indies	\$1,848,724	\$1,688,962
Spanish West Indies	2,136,168	1,078,273
Brazil	1,068,876	493,549
British Guiana	203,358	237,100
Other South American States ...	83,693	679,048
	<hr/>	<hr/>
	\$5,340,819	\$4,176,932
Total imports and exports	<hr/>	<hr/>
	<u>\$9,517,751</u>	

CHIGNECTO MARINE TRANSPORT RAILWAY.

ESTIMATE OF THE PROBABLE TRAFFIC TO BE DEVELOPED BY THE PROPOSED IsthMIAN TRANSIT.

ARTICLES OF COMMERCE.	FROM.	TOWARDS.	TONS.	AUTHORITY.
<i>Products of the Forest.</i> —All kinds of short or small lumber, planks, deals, boards, battens, scantling, clapboards, cedar and pine shingles, laths, palings, pickets, ship timbers, knees, masts, spars, cedar sleepers, pine lacmatae railway ties, telegraph poles, spiling, hemlock bark, hemlock boards, staves, hoops, sugar box shooks, black ash, elm, maple. Pine boards, oak, elm, walnut, ash.	The north shore of N. Brunswick, N. Scotia, Bay Chaleurs and Gaspé Basiu. Estimated at forty million superficial feet.	St. John, United States, West Indies, Guiana, Brazil, Buenos Ayres.	80,000	Senator Muirhead. W. Elder, M.P.P. Ed. Jack, C.E. F. C. Winslow. Hon. J. W. Lawrence. Hon. J. Boyd. J. Pickard, M.P.
<i>Products of the Western Provinces.</i> —Flour, meal, barley, oats, corn, wheat, pork, beef, hides, mineral oil, agricultural implements, machinery and other heavy manufactures, phosphates, ores, &c.	Montreal, Toronto, Chicago, and all lake ports.	Coming in the lake propellers to St. John, can there exchange for southern products, and coal, plaster and stone.	Total tons	J. Pickard, M.P. Hon. J. Young at meeting of Dominion Board of Trade in 1871. Hansard, 1876. p. 1,144.
			Total tons	50,000

<i>Agricultural and animal products from Prince Edward Island and Cape Breton (west coast).—Potatoes, roots of all kinds, oats, beans, peas, pressed hay, lard, tallow, wool, horses, cattle, sheep, swine, dairy produce, poultry, hides, pelts.</i>	Ports of Charlottetown, Summerside, Georgetown.	To St. John, Portland, Boston, Providence, New York, West Indies.	C. Burpee, M.P. Hon. J. C. Pope. J. C. Hall. W. Elder, M.P.P. Hon. J. S. Carvell.
	Total tons	50,000	
<i>Products of the Sea and the Fisheries of the Gulf of St. Lawrence.—Fish of all kinds, cured, frozen, pickled, canned, dried or alive; cod, halibut, mackerel, ling, pollock, salmon, capelin, herring, smelt, alewives, lobsters, oysters; also cod, seal, porpoise and whale oils.</i>	Ports of the United States, north and south, Cape Cod, New Bedford, Gloucester, New York, New Orleans, West Indies, Brazil, Buenos Ayres.	B. G. Lant. J. C. Hall. W. Elder, M.P.P. Hon. R. Marshall. C. Milner. Alex. Wright.	
	Total tons	60,000	H. A. Budden. F. Newbery.
<i>Products of Mines and Quarries.—Coal from Pictou for steam purposes; freestone, plaster, rough and calcined, grindstones, marble and slate, and ores.</i> <i>Coal from Sydney, via St. Peter Canal.</i>	Pictou, Port Hood, Wallace, Cape Breton (west coast), Gloucester. New Sydney.	To United States ports, West Indies, St. John. St. John.	Hon. J. Boyd. A. Wright.
	Total tons	50,000	To United States, and to St. John, and to winter in Bay of Fundy.
<i>Miscellaneous products.—Merchandise, vessels seeking short cut and looking for cargoes; steamers, tugs, schooners and small craft generally going to winter in St. John.</i>	Quebec and Gulf ports, P. E. Island.	Total tons	Report on Baie Verte Canal, p. 11. C. Burpee, M.P.
		15,000	Carried forward ...
		305,000	

ARTICLES OF COMMERCE.	FROM.	TOWARDS.	TONS.	AUTHORITY.
RETURN TRADE.		Brought forward...	305,000	
<i>Tropical and semi-tropical products.—</i> Sugar, molasses, cotton, coffee, hides, tallow.	South America, Brazil, Guiana, West Indies, Southern States, and exchangeable at St. John for Western Canadian products and manufactures.	To Montreal, Quebec, Toronto, and all lake ports, also to Gulf ports and P. E. Island. Total tons	60,000	Hon. J. Boyd. Hon. J. Young, speech at Dominion Board of Trade, 1871. J. Pickard, M.P. C. Milner.
<i>Products of the mine.—</i> Bituminous coal of Nova Scotia.	From the collieries of Cumberland Co., South Joggins, Spring Hill, Hibbard, Lawrence, Milner, and other mines of Macan and River Hebert. <i>via</i> St. John and direct.	Montreal, Toronto, Quebec, and all lake ports, also to P. E. Island and all Gulf ports. To same ports, St. John and direct.	Total tons	Quebec Board of Trade, J. W. Lawrence, Alex. Wright. C. Milner. Hon. J. Boyd. Sen. Dickey. Hon. W. Muirhead.
Also anthracite coal from Pennsylvania.		Total tons	80,000	
<i>Products of the quarry.—</i> Olive, grey and brown freestone.	Dorchester, Hopewell, Harvey, St. Mary's Bay, Woody Point. St. George, Charlotte. St. John County. Londonderry Mines. Five Islands and Minudie.	Quebec, Montreal, Toronto, and all cities and towns of the western provinces.	Total tons	Hon. J. W. Lawrence. Hon. J. Boyd. Hon. R. B. Dickey.
Red granite. Grey granite. Iron, marble, lime grindstones, scythe and whet stones and ores.			50,000	

Plaster (gypsum) in the rough, used as a fertilizer, and manufactured calcined plaster.	Windsor, Martin's Head, Hillsboro, Shepody.	To Ontario and the west.	J. G. Tompkin. W. Elder, M.P.P.
<i>Merchandise, manufactures and supplies.</i> —Being the return propeller cargoes in exchange for lumber from north shore N.B., N.S., and Quebec, and agricultural products of P.E. Island.	United States, St. John, and Bay of Fundy ports.	To Quebec and all Gulf ports.	Total tons 40,000
<i>Miscellaneous.</i> —The fishing fleets with bait and supplies, and other cargo, vessels seeking cargoes, steamers, tugs, smacks and small craft.	Outfitted in United States or in Bay of Fundy or St. John.	For the Gulf Fisheries, Labrador, Anticosti, Bay Chaleur, Gaspé Basin.	Total tons 35,000
		Hon. J. W. Lawrence. Senator Dickey.	Total tons 30,000
			GRAND TOTAL..... <hr/> 600,000

Mr. Francis Hall, C.E., the Engineer sent out from England in 1825 to survey the Isthmus, estimated the Traffic at twenty vessels *per diem* at that period.

THE MARINE OF CANADA.

Canada ranks fourth on the list of nations as to commercial marine, being only exceeded by Great Britain, the United States and Norway.*

The number of vessels in the register of the Dominion at the end of the year 1882, was 7,312, with a net tonnage of 1,260,777 tons; of these, 783 were steamers of 99,716 tons register; 288 new vessels measuring 60,113 tons, were added during the year, 66 of which were steamers.

The tonnage of the Dominion is divided as follows:—

New Brunswick	...	1,065	vessels,	308,980	tons.
Nova Scotia	...	3,026	"	546,778	"
Quebec	...	1,754	"	215,804	"
Ontario	...	1,112	"	41,684	"
Other Provinces	...	355	"	147,531	"
<hr/>		<hr/>		<hr/>	
Total	...	7,312	"	1,260,777	"
<hr/>		<hr/>		<hr/>	

The following Official Table is found on page 858 of the "Tables of Trade and Navigation of the Dominion of Canada" for the Fiscal year ending 30th June, 1882, compiled from official returns at Ottawa.

STATEMENT OF BRITISH AND FOREIGN VESSELS EMPLOYED IN THE COASTING TRADE OF THE DOMINION.

	DESCRIPTION OF VESSELS.					
	ARRIVED.		DEPARTED.		TOTAL ARRIVED & DEPARTED.	
	Number	Tonnage.	Number	Tonnage.	Number	Tonnage.
STEAMERS—						
Screw	9,126	1,780,479	9,173	1,808,698	18,299	3,589,177
Paddle	9,681	4,319,171	9,458	4,075,040	19,139	8,394,211
Stern Wheel	147	105,013	147	105,153	294	210,166
SAILING VESSELS—						
Ships	4	5,243	4	3,433	8	8,676
Barques	127	76,234	170	91,884	297	168,118
Barquentines	8	1,942	9	3,161	17	5,103
Brigs	27	7,136	30	8,116	57	15,252
Brigantines	228	47,929	285	56,661	513	104,590
Schooners	16,317	891,212	16,225	848,017	32,542	1,739,229
Sloops	1,010	55,068	985	55,105	1,995	110,173
Barges, Canal Boats, &c.	1,321	226,049	1,284	220,320	2,605	446,369
Total Coasting Vessels	37,996	7,515,476	37,770	7,275,588	75,766	14,791,064

* See Appendix.

Of this total tonnage indicated by the entries and clearances, there were 6,321,610 tons particularly belonging to the Maritime Provinces, including Quebec, New Brunswick, Nova Scotia, and Prince Edward Island.

The estimate of 600,000 tons before given as the probable amount of traffic over this Railway is, therefore, less than 10 per cent. of the above tonnage.

The Board of Trade of St. John, New Brunswick, passed the following resolutions on the 20th October, 1883 :—

“ *Whereas*, means of communication between the waters of the Bay of Fundy and the Gulf of St. Lawrence, whereby products of the several Provinces bordering thereon may be interchanged without encountering the dangerous navigation of the Atlantic coast of Nova Scotia, whereby steamers and sailing vessels, adapted as well for inland as for ocean navigation, may be safely conveyed across the Isthmus of Chignecto, without the cost and delay of transhipment or breaking bulk and whereby the sailing distance between this port and all ports north and west of said Isthmus may be reduced about 600 miles—would materially increase the volume of trade and benefit the shipping interests of this port and other ports in the Bay of Fundy and Gulf of St. Lawrence ; and

“ *Whereas*, by means of a ship railway across said Isthmus, the objects aforesaid may be accomplished and thus stimulate the development of the agricultural, mining, lumbering and fishing resources of the district contiguous to the aforesaid ports ; and

“ *Whereas*, a company has been formed for the construction and operation of a ship railway with commodious docks and hydraulic lifts for raising and transporting over its line laden vessels of 1,000 ton displacement ; therefore

“ *Resolved*, That this Board is of opinion that the undertaking of said company would greatly facilitate trade and commerce between the eastern and western provinces ; and further

"Resolved, That this Board cordially approves the project for building the said ship railway, believing that this is a movement which will commend itself to all classes, and prove to be of great convenience and benefit to our trade and commerce generally."

The residents and freeholders of the County of Cumberland, through which the railway line runs, have, by instrument, dated 9th October, 1883, guaranteed to provide all the lands required for the railway and docks, and procure the necessary conveyances for the same free of and from all charges and expenses to the Company.

The Government of Canada have provided a subsidy of \$150,000 per annum for twenty-five years, to be granted the Company during the operation of the railway. A further grant in aid of the docks, to the extent of an additional \$25,000 a year, for the same period, is confidently expected to be given at the coming session of Parliament.

DESCRIPTION OF THE SHIP RAILWAY.

The line of Railway is to be perfectly straight.

The Gradients will be virtually level, none exceeding the ratio of 1 in 2,000.

The length is to be seventeen miles.

There is to be a Dock at each end of the line, where vessels will be received in quiet water previously to transportation.

In each of these docks there will be erected an Hydraulic Ship Lift, somewhat similar in construction to those in operation at the Victoria Docks on the Thames and at Malta.

These Lifts will be especially designed to raise loaded vessels with absolute safety. A Ship Carriage or Cradle resting on wheels and provided with keel blocks and bilge guards will be first placed on the rails which rest on the gridiron of

the lift. This gridiron, which is actually a portion of the railway, is lowered with the cradle upon it and immersed in the water to the bottom of the dock.

The vessel which it is proposed to transport will then be guided to and floated exactly over the cradle—the keel and bottom of the vessel corresponding with the line of blocks and cushions previously arranged to receive her. The arrangement of the blocks and cushions will vary according to the lines of the various crafts to be transported. Once in the proper position the gridiron will be raised to the level of the keel, and then the blocks will be hauled in while under water, close to the vessels bilges and sides. A rack with palls at the back of the blocks prevents any movement. The operation of raising the whole mass then begins by means of the hydraulic presses ranged on both sides of the gridiron.

The length of stroke is forty feet in each lift. The engines and presses are calculated to raise the maximum sized vessel, with cargo, to the level of the railway in the space of ten minutes. When the lifting process is finished the rails on the gridiron will correspond in level and coincide in line with the railway track on *terra firma*, the gridiron will then be locked securely to this level, so that by means of an accumulator and another hydraulic apparatus the cradle and ship together may ~~then~~ be hauled off the lift and thus transferred to the railway, where they will be ready for transportation by means of locomotives.

The principle is simply a combination of the hydraulic ship lift with a marine slip or railway extended, either of which may be seen in this country in daily operation.

The operation of lifting vessels with cargo of much greater registered tonnage than contemplated here has been most successfully performed at the Malta Hydraulic Dock for many years without the slightest failure, although that dock was not specially designed for lifting loaded vessels as these will be on the Ship Railway.

The work of hauling will be done by locomotives especially constructed for the purpose instead of by stationary engines as on a marine slip, thus doing away with costly stationary engines, ropes and gearing, besides performing the service in a much quicker time.

Two locomotives will haul the largest vessel to be transported (not to exceed 1,000 tons weight) at the rate of ten miles an hour, or at greater speed, if necessary, for smaller class vessels.

The locomotives and cradles will be supplied with powerful brakes and appliances for both stopping and starting the load whenever required.

When the vessel and cradle have arrived at the other end of the railway, the locomotive will be passed into a siding, and the vessel and cradle will be pulled on to the other hydraulic lift in the same manner and by the same appliance that they were first hauled on to the railway. They will then be lowered and deposited into the water; and as the gridiron sinks into the bottom of the dock, the vessel floats herself off and may then be pulled into the dock, or if a steamer may steam away to her destination.

The empty cradle is then again raised to the level of the railway, rolled on to a traverser platform where it will be shunted to one side, thus leaving the line clear for a succeeding vessel to undergo the same operation.

It will thus be seen that the whole operation is simple, rapid, and economical, scarcely any expense besides that of the lifting, hauling, and depositing being necessary.

The weight of the vessel and cargo as shewn by her displacement is not to exceed, according to the Government requirement, 1,000 tons dead weight, or a vessel of 500 tons register laden.

The line of railway itself will be of the most substantial character. It has already been set out and levelled. The most ample borings have been taken and test pits dug

to test the nature of the foundations and the quality of the material. The result has shewn a bed of rock extending over the entire distance.

There will be four lines of steel rails of 90 lbs. weight per lineal yard. The cradle for the largest vessel will be supported on bogie trucks so that the weight, evenly distributed, would not exceed 5 tons on each wheel. To provide for any unequal distribution the wheels and axles will be designed to bear more than double that weight.

"The London and South Western express engines have 9 tons on a wheel, and the rails weigh 82 lbs per yard. The Great Northern engines have about the same weight on their express heaviest loaded wheels. On the Great Northern the armour plated trucks have 8·4 tons on a wheel, and the latter are spread 5 feet 6 inches apart, therefore load equals 3 tons per foot of line. Their heaviest tank engines weigh 55 tons on 12 feet 10 inches base, and the equivalent load is also 3 tons per foot as the wheels are spread 4 feet 9 inches apart. The Great Northern rail is 82 lbs. The above loads traverse at high speed not occurring on ship railways so heavier loads might be put on that rail."

The ballast of the railway will be composed of broken macadamized stone to the depth of 15 inches under the sleeper. The roadway will thus secure immunity from damage by frost and possible upheaval.

The sleepers will be 9 x 12, of southern pitch pine, and will at intervals extend the whole width of the track.

The fastenings will be of special improved pattern. The fish plates being arranged so as to be secured to both rail and sleepers.

REVENUE.

It is agreed that the Government of Canada will not interfere with the tolls to be charged until a dividend of

10 per centum shall have been paid on the Share Capital of the Company.

Assuming the estimate of traffic before given to be correct, and that 600,000 tons of merchandize will annually pass over the line, it will require an equal amount of register tonnage of hulls to carry that amount.

The revenue greatly depends on the manner of regulating the tolls, but the following general principles will be observed :—

1. To encourage and develop non-existent trade by low rates at first until the railway is worked up to its full capacity.
2. To discriminate as to nature of cargo, its destination and distance travelled.
3. To compete with freights around Nova Scotia.
4. To make a charge on the hull as well as on the cargo.
5. To regulate the charges on the cargoes by weight, measurement or capacity..
6. To make special rates for regular running lines of steamers.

A fair general average rate would be fifty cents per ton on the cargo and ten cents per ton on the hull.

The revenue at this rate would be—

600,000 tons at 60 cents	...	\$360,000.
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WORKING EXPENSES.

It is obvious that on the foregoing valuation and conditions of tolls being upon both hull and cargo, the whole load transported is a paying one, excepting the cradle. That is to say if 1,000 tons weight be carried on a cradle weighing but 250 tons, as estimated, the paying load bears to the dead weight the proportion of four to one.

It is therefore a freight line wholly.

The speed slow.

The line level and straight.

No station expenses.

The freight loads and unloads itself.

Works so substantially built that repairs and maintenance will be light.

The cost, therefore, of working will be but little more than inexpensive maintenance and locomotive power, added to the cost of lifting and depositing vessels from and to the docks.

The proportionate cost of locomotive power to gross earnings in English railways is $17\frac{1}{2}$ per cent.

From ten years' experience of working the Inter-Colonial Railway of Canada in the Province of New Brunswick, the result as to the cost of locomotive power, is as follows :—

Per ton per mile of gross weight hauled.			
Wages	... Drivers, Stokers, Cleaners...	.0632	of one cent.
Fuel	... Coal, in the locality ...	.0597	"
Materials	... Oil, Tallow, Waste ...	.0160	"
Repairs	... Engines, Cars, &c. ...	.0908	"
Water	... Tanks, Pumping, &c....	.0124	"
Stores	... Miscellaneous ...	.0079	"
Total per ton per mile			.25 of one cent.

Assuming the gross weight on the ship railway to be double the paying freight; which is an unfavorable comparison, as before shewn,—the foregoing result of working an ordinary railway in the country shows that it costs for locomotive power one-half cent per ton per mile, or, one farthing, English money—which is equal to $8\frac{1}{2}$ cents or 4d. per ton for the whole transportation of seventeen miles.

In addition to this, the cost of lifting and depositing vessels on and off the railway is estimated as follows :—

Supposing the engines working the presses all day long : expense of fuel, $2\frac{1}{2}$ lbs. coal per horse power per hour for ten hours, working up 600 h.p. indicated—

Seven tons of coal at \$2 per ton	...	...	\$14.00
Wages : Engineer, foreman and all hands	...	...	20.00
Working at docks	...	...	2.00

	For one lift	...	36.00

	For both lifts	...	\$72.00

3,000 tons per diem lifted and deposited, costing \$72 is equal to $2\frac{1}{2}$ cents per ton or equal to $1\frac{1}{4}$ d.

Maintenance of railway and including all office and other expenses, \$45 per diem (but excluding administration of Company, provided for otherwise). This on 3,000 tons per diem during season of open navigation would equal $1\frac{1}{2}$ cents per ton additional.

Result of above estimate is as follows :—

Cost of locomotive power	...	...	$8\frac{1}{2}$ cents.
Cost of working lifts	...	...	$2\frac{1}{2}$ "
Cost of maintenance	...	...	$1\frac{1}{2}$ "
...	...		_____
	Total	...	$12\frac{1}{2}$ cents.

Total for seventeen miles, 6d. per ton, which is exactly twenty-five per cent. of the receipts on the cargoes.

RECAPITULATION.

Gross Earnings.

On Cargoes, 600,000 tons at 50 cents = \$300,000

On Hulls, 600,000 tons register at 10 cents = 60,000

_____ \$360,000

Working Expenses, 25% \$90,000

Net Earnings \$270,000

NAVIGATION IN THE BAY OF FUNDY.

The following is an Extract from the Report of Samuel Keefer, C.E. :—

“The Bay of Fundy is remarkable for the extraordinary range of its tides. It is one of the wonders of the world, and the wonder is, that such a prodigious volume of water as enters and leaves it twice a day does not produce a greater commotion. On the direct course up the Bay to Cumberland Basin, and in the basin itself, there is no bore ; the water being too deep and the course too direct to admit of such a phenomenon. Having observed the operation of the tides, both at Laplanche and Au Lac, I was surprised to see with what ease and regularity it was done. The surface of the great Basin rises and falls almost imperceptibly, all the while preserving, in the absence of any wind, the placid appearance of a lake.

“The range of the tide at St. John is 27 feet for springs and 23 for neaps, while according to the Departmental survey, it is 48 feet for springs and 38 for neaps at the head of Cumberland Basin.

“Here then, according to moon’s position, and the other causes which influence the tides, the water rises from 19 to 24 feet above the mean level of the sea, and falls from 19 to 24 feet below the same level, twice in every 24 hours. At one time the water is piled up to a height of 24 feet above the average level of the sea, and at another, just so much is taken out of the bay below that level. Like the oscillations of a pendulum, or the arms of a balance, these vast bodies of water vibrate about the neutral axis, represented by the average level of the sea ; and furnish a striking example of the stupendous forces that govern the motion of the tides—yet so gradual are the changes that, with care and skill, this bay can be navigated, except in bad weather, with perfect safety.”

The Insurance on vessels will be from 1 to $1\frac{1}{2}$ per cent. less by Bay of Fundy than by Gut of Canso.

HISTORY OF THE PROJECTED CANAL.

This Paper would be incomplete without some reference being made to the long projected Baie Verte Canal, in place of which this Ship Railway has been substituted, and the reasons for the substitution.

The history of the Canal project will demonstrate the importance of an Isthmian transit of some kind. The difficulties attending the construction of a canal arose out of the constantly increasing demands of commerce since its first inception, as will be seen by the following facts.

In 1822, a survey was made by New Brunswick Government for a canal to be fed by fresh water with a depth of *four* feet.

In 1825, another survey was made by Francis Hall, C.E., for a canal having a depth on the lock cills of *eight* feet.

In 1826, Sir Thomas Telford reported on the survey of Mr. Hall, recommending larger dimensions and a depth of *thirteen* feet.

In 1843, Captain Crawley, Royal Engineers, after making a survey at joint expense of New Brunswick, Canada and Prince Edward Island, pronounced canal of even *nine* feet depth impracticable on account of deficiency of fresh water supply; and he objected to using Bay of Fundy tidal water to supplement the deficiency, on account of its turbid nature and great quantity of mud held in suspension in that water.

In 1869, John Page, Chief Engineer, Public Works of Canada, is of opinion that by adopting a *lower* level an abundant supply of fresh water may be obtained, and that the Bay of Fundy water should be prevented from entering the canal.

In 1872, Mr. Baillargé recommended water supply to be taken from Bay of Fundy, by using one or two rivers as reservoirs and settling ponds, and a navigable draft of *fifteen* feet.

In 1872 Messrs. Keefer and Gzowski recommend a half-tide canal, twenty miles and a half long, at a cost of \$5,317,000.

In 1871, Mr. Baillaigé estimates a canal based on Mr.			
Keefer's project for 12 hours	...	...	\$5,650,000
And based on his own project for 16 hours			8,217,849
Also cost of a whole-tide canal	...	...	8,592,849

Total length of canal, nineteen and a quarter miles.

In 1873, Mr. Page condemns Mr. Keefer's project and approves Mr. Baillaigé's, and submits estimates of cost as follows:—

For a half-tide canal	...	...	...	\$7,700,000
Three-quarter-tide canal...			...	8,100,000
Full-tide canal	...	...	...	8,500,000

He reports "that the construction of a navigable channel between the Bay of Fundy and the Gulf of St. Lawrence, on any line that can be selected, will be an undertaking attended with unusual difficulty, not only from the nature of the work to be done, but from the great difference in the elevation of the respective tides."

The locks were to have a width of 40 feet, and the canal a navigable draft of *sixteen* feet.

The canal would take eight years to complete, consequently the cost of interest during construction would add to the estimate above mentioned, and bring it up to \$12,000,000 for a full-tide canal. The width of the locks was not sufficient to admit paddle-wheel steamers, which must be the chief means of transport for general merchandise, being specially suited for the shallow harbours of the Gulf of St. Lawrence.

To widen the locks and to protect the sides of a Canal from the wash caused by steamers would greatly increase this estimate.

The importance of this omission to provide for the transfer

from Gulf to Bay of the most numerous tonnage of the inland coasting trade of Canada may be illustrated by the fact that in 1882, out of 14 million tons of entries and clearances not less than 8,394,000 tons consisted of paddle wheelers ; and out of all these steamers now plying in the Bay of Fundy and Gulf of St. Lawrence not one could have passed through the canal.

ADVANTAGES OF A SHIP RAILWAY.

The advantages that a Ship Railway would possess in this locality over any canal, were fully demonstrated to the Government of Canada before the subsidy was granted by that Government ; they are in fact self evident, and may be enumerated as follows :—

The Ship Railway can transport vessels of greater width and draught than the proposed Canal was designed for.

It would be open for the transport of vessels at an earlier date in the season than a canal could possibly be, and could be used when the Gut of Canso is closed by ice.

The transportation of vessels would be more quickly performed.

The execution of the work would take but one-third the time.

Its cost is more accurately estimated and is but one-fourth that of a canal that would accommodate the same sized vessels.

The maintenance, repairs, and operating are less expensive owing to the difficulty there would be in keeping the works of a canal free from injury by frost and ice. Owing to the fact that in summer, southerly winds prevail with the regularity of trade winds, it would then be almost impossible to sail a vessel through the canal from the Gulf of St. Lawrence to the Bay of Fundy ; the task of towing would be nearly as expensive as transportation by rail.

The capacity of the Ship Railway can likewise be more easily increased to meet the demands of commerce, whether as to size of vessels, or as to the number of them.

APPENDIX I.

Extract from "REPORT OF MARINE AND FISHERIES, 1881."

STATEMENT showing the Sea-going Tonnage, and Tonnage of Steamers over 100 tons register, of each of the Maritime States of the world, taken from the "Répertoire Général" for 1880 and 1881.

Nationality.	Steamers.	Gross Tonnage of Steamers.	Net Tonnage of Steamers.	Sailing Vessels.	Net Tonnage of Sailing Vessels.	Total Net Tonnage.
British (including Canada and the Colonies	3,787	4,265,519	2,773,082	18,352	5,486,666	8,259,748
American	548	634,292	389,937	5,958	2,048,975	2,438,912
Norwegian	148	67,636	49,067	4,160	1,371,721	1,420,788
Canadian*	918	190,159	120,141	6,459	1,191,077	1,311,218
German	277	289,429	203,322	3,113	953,856	1,157,178
Italian.....	103	107,070	72,813	2,936	913,782	980,595
French	335	423,787	277,781	2,772	541,853	819,634
Russian	166	128,729	82,843	1,875	426,226	509,069
Swedish	258	98,969	69,292	1,979	399,237	468,529
Spanish	226	205,498	135,814	1,578	325,036	460,850
Dutch	111	118,260	80,632	1,112	332,750	413,382
Greek	20	14,237	9,526	1,672	321,777	331,303
Austrian	82	93,142	62,114	599	237,790	299,904
Danish	109	74,987	47,844	1,172	177,839	225,683
Portuguese	17	16,253	10,946	424	99,572	110,518
South American..	37	61,198	40,401	254	86,400	126,801
Turkish	10	8,866	5,579	374	61,738	67,317
Central American	10	4,572	2,803	144	47,702	50,505
Belgian	40	64,773	44,747	29	13,067	57,814
Asiatic.....	33	38,984	24,210	54	21,593	45,803
Egyptian	18	18,212	11,859	.....	.....	11,859
Roumanian.....	1	166	111	20	3,443	3,554
Tunisian	1	1,067	726	2	188	914
Liberian .....	.....	.....	.....	2	317	317
Syrian.....	.....	.....	.....	1	293	293
Unknown	5	9,552	6,302	2	1,159	7,461
Totals	6,392	6,745,198	4,401,751	48,584	13,872,980	18,274,731

* The figures for Canada are not added in the columns, as Canada's tonnage is included in the tonnage of Great Britain.

I have the honor to be, Sir,

Your most obedient Servant,

W.M. SMITH,
Deputy Minister of Marine and Fisheries.

DEPARTMENT OF MARINE AND FISHERIES,
OTTAWA, June, 1881.

APPENDIX II.

45 VICTORIA.

CHAP. 55.

An Act to provide for the granting of a Subsidy to the Chignecto Marine Transport Railway Company, Limited.

[Assented to 17th May, 1882.]

Preamble. IN consideration of the great advantages which would accrue to the Maritime Provinces and the intercolonial trade of Canada generally from the construction of a Ship Railway across the Isthmus of Chignecto from Tignish, on La Baie Verte, in the Gulf of St. Lawrence, to a point at the mouth of the River La Planche, on the Bay of Fundy, and of the proposal made by Mr. H. G. C. Ketchum, on behalf of a Company formed and to be incorporated as "The Chignecto Marine Transport Railway Company, Limited," and approved by the Governor in Council on the report of the Minister of Railways and Canals, after consultation with the Chief Engineers of the Department; Her Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:—

Conditions
on which
a subsidy
may be paid
to the said
Company
during
twenty-five
years.

If the works
are in good
order.

1. If the said Company do, within seven years from the first day of July now next, construct such ship railway, according to the terms of their said proposal, and of an agreement and contract in that behalf which the Government of Canada may, if they see fit, make with the said Company, in a substantial manner and fully equipped for the services therein to be stipulated, to the satisfaction of, and subject to the approval of the said Government; then during a term of twenty-five years from the date of such approval, provided the said ship railway is kept in thorough repair and satisfactorily performs the services aforesaid, a subsidy at the rate of one hundred and fifty thousand dollars a year shall be paid to the said Company out of the Consolidated Revenue Fund of Canada, such subsidy not being payable for any period during the said twenty-five years during which the conditions above mentioned shall not be complied with.

